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Manhart, Klaus

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Klaus Manhart

BALANCE THEORIES: TWO RECONSTRUCTIONS AND THE PROBLEM OF INTENDED APPLICATIONS

ABSTRACT. Balance theories were an important research program in social psychology and sociology. Initiated by the Austrian psychologist Fritz Heider a number of theories with a different degree of complexity and a varying domain of applications was developed. Beyond their theoretical and empirical insights balance theories played a decisive role in the methodological discussions between the fifties and seventies.

In this paper a reconstruction of two balance-theory-elements is given: the original theory by Heider, that deals with cognitive entities, and an advanced theory proposed by (Holland , Leinhardt 1971), that deals with interpersonal relations. On the basis of these reconstructions, the problems surrounding the empirical applications of balance theories are analyzed. Starting with the core application some balance theorists suggested to enlarge the domain of intended applications. A short excerpt of some central arguments demonstrates that the intended systems of the balance theory were controversial. In this case the 'method of autodetermination' should be applied: the theory's formalism itself is left with the responsibility of deciding what its applications are to be. This example demonstrates again, that the domain of applications is independent of the theory's core.

I. Introduction

Balance theories are one of the most influential theoretical trends in social psychology and sociology. Initiated by Fritz Heider 1946, balance theory played a decisive role in the social sciences between the fifties and seventies. First, it gave rise to a large number of experiments and encouraged the development of other, more complex balance theories (e.g. Osgood, Tannenbaum 1955; Cartwright, Harary 1956; Abelson, Rosenberg 1958; Morrissette 1958; Davis 1963, 1967; Gollub 1974; Mohazab, Feger 1985). Second, it stimulated more general reflections on the possibility of formalization in the social sciences (see Sukale 1971). In this chapter a reconstruction of two balance theory-elements is given: the original theory by Heider, that deals with cognitive entities, and an advanced theory proposed in (Holland, Leinhardt 1971), that deals with interpersonal relations. Furthermore, the problems and discussions surrounding the empirical applications of balance theories are analyzed in the light of the structuralist view of theories.

II. Heider's Balance Theory

The background of Heider's theory is the assumption, that social perception follows 'gestalt-like' structure principles (Heider 1946, 1958). People try to avoid inconsistencies and reorganize their attitudes and behavior to reestablish consistency, if necessary. For example, the cognitions 'I like smoking' and 'Smoking is unhealthy' are psychologically inconsistent. The balance principle asserts that consistent or 'balanced states' are preferred over imbalanced states. An imbalanced state gives rise to a tendency or pressure to gain or regain a balanced state. There are different ways to achieve such balanced states. In the example given above, a person could, among other things, stop smoking or reorganize her attitude to smoking by changing or even ignoring her negative evaluation of smoking (e.g. 'smoking isn't as unhealthy as experts claim').

In Heider's theory, the states of 'balance' and 'imbalance' are applied to cognitive units that consist of three elements and pairwise relations between them. This cognitive structure is formed by a person *o* (whose behaviour is to be explained), another person *o*', and an impersonal object *i* (for example: an event, an opinion, or a group/institution). *o*, *o*' and *i* are represented in the cognitive system of *o*, together with the relations that exist between them. Examples of such triadic cognitive systems (for short: triads) are:

(Ex1) *o* is a friend of *o*' and both have a negative attitude to religion *i*.

(Ex2) *o* is married to *o*' and *o*' elects a political party *i* which *o* rejects.

Between the cognitive units, there can be two kind of relations, each of which can be positive or negative: Attitudes or Liking-relations (L-relations: to like, to love, to value and their opposites), and Unit-relations (U-relations), that is, relations in which the units are perceived as belonging together (e.g. similarity, causality, membership). However, for a cognitive system to be balanced or imbalanced, the nature of the relations between elements (L- or U-relations) is not decisive; only the number of positive and negative relations is important.

On the basis of the concepts just introduced, several axioms of the Heider-theory can be formulated. The first two definitions characterize the basic concepts of Heider's theory set-theoretically and introduce a number of abbreviating symbols. Definition 1 introduces the set-theoretical predicate '... is a Heider-graph', and thus the triads of the cognitive system.

Definition 1:
$\mathbf{x} = \langle O, P, N \rangle$ is a *Heider-graph* ($\mathbf{x} \in \mathbf{HG}$) iff there exist O, P and N such that:
(1) O is a set with 3 elements
(2) $P \subseteq O \times O$
(3) $N \subseteq O \times O$
(4) $P \cap N = \varnothing$
(5) For all $x \in O$: not $\langle x,x \rangle \in P \cup N$
(6) If $x,y \in O$ then $\langle x,y \rangle \in P \cup N$ or $\langle y,x \rangle \in P \cup N$

Axioms (1)-(6) define a Heider-graph as a set O of three elements where P and N are relations defined on O (2,3) that are disjoint (4) and irreflexive (5). Axiom (6) claims the completeness of the structure, that is, it requires that either a P- or N-relation must exist between any pair of elements from O. The basic terms have the following interpretation: O is a set of persons and non-persons and P and N are the sets of positive and negative relations within the elements of O.

Definition 2 introduces some useful abbreviations.

Definition 2:
If $\mathbf{x} = \langle O, P, N \rangle \in \mathbf{HG}$ then:
(1) $R := P \cup N$
(2) $x \in NP$ iff $x \in O$ and there is no y, such that $y \in O$ and xRy
(3) $x \in PE$ iff $x \in O$ and not $x \in NP$
(4) $TR := R \times R \times R$

Axiom (1) introduces R as the union of P and N. Axioms 2 and 3 distinguish persons from non-persons. Non-Persons are defined as those elements of O which are not the left-hand arguments of a relation, and persons as those elements of O, which are not non-persons. Axiom 4 defines triads TR as the set of triples of positive or negative relations.

The definitions characterize set-theoretically the triads or Heider-graphs represented in Figure 1. Fig. 1 illustrates all eight possible combinations of P and N relations within a triad. We have now to define which of these eight triads are balanced and which are not. According to (Heider 1946, 1958), structures (a)-(d) are in balance, because these structures are perceived as pleasant, harmonic and coherent. Accordingly, example Ex1, which corresponds to triad (b) of Fig. 1, would be balanced. By contrast, the triads (e)-(g) are imbalanced and psychological tension is produced to change this status. Accordingly, example Ex2 is imbalanced, because it corresponds to triad (f). A special position is occupied by triad (h) with three N relations, which (Heider 1958) did not classify as clearly balanced or imbalanced, but as 'somehow ambiguous'. This 'ambiguous' triad played an important role in the subsequent theoretical developments of balance theory (e.g. Davis 1967).

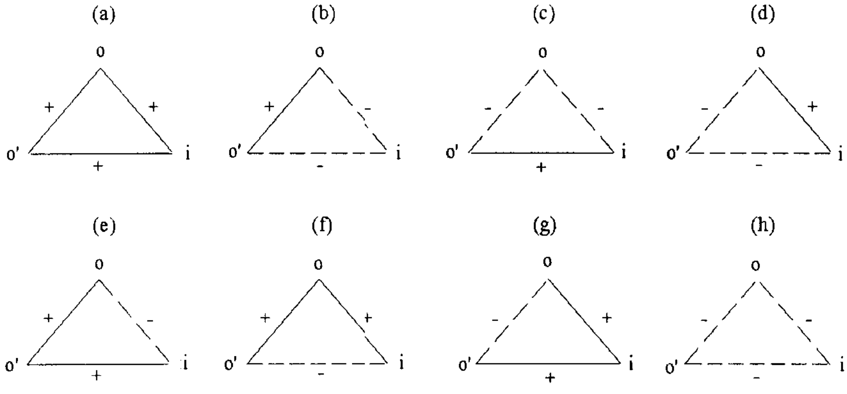

Fig. 1. Balanced and imbalanced triads according to (Heider 1946). Lines drawn through and marked with '+' mean positive, dotted lines marked with '-' mean negative relations.

Definition 3 determines balanced, imbalanced and indefinite triads as subsets G (balanced), U (imbalanced) or I (indefinite) of TR.

Definition 3:

If $\mathbf{x} = \langle O,P,N \rangle \in \mathbf{HG}$ then TR is separated in subsets $I, G, U \subseteq TR$ as follows:

(1) $I = \{\langle a,b,c \rangle \mid a,b,c \in N\}$

(2) $G = \{\langle a,b,c \rangle \mid a,b,c \in P \vee (a \in P \wedge b,c \in N) \vee (b \in P \wedge a,c \in N) \vee (c \in P \wedge a,b \in N)\}$

(3) $U = \{\langle a,b,c \rangle \mid (a \in N \wedge b,c \in P) \vee (b \in N \wedge a,c \in P) \vee (c \in N \wedge a,b \in P)\}$

Heider's fundamental theoretical statement is that imbalanced structures are perceived as discordant and stressed and therefore tend to be changed into pleasant and harmonic balanced states. This 'balance principle' forms the fundamental law of Heider's theory, and it is also shared by all other balance theories. However, Heider's theory does not make any explicit predictions about which modifications will occur in an imbalanced system, thus, which of the balanced triads will be produced: Imbalanced triads only tend to become balanced.

Because Heider addresses changes of triads over time, a set of ordered time points must be added to the basic terms. With this additional set, the concepts of the Heider-theory are complete. Using this conceptual apparatus it is now possible to look at Heider-graphs at different points of time. From a structuralist point of view, a temporal sequence of triads forms a possible or potential model. The set of these potential models is $\mathbf{M_p}$.

Definition 4:
$\mathbf{x} = \langle O, T, <, P, N \rangle$ is a *potential model* of Heider's theory ($\mathbf{x} \in \mathbf{M_p(HT)}$) iff there exist $O, T, <, P, N$, such that:
(1) $\langle T,< \rangle$ is a finite, linear order
(2) $P: T \rightarrow \wp(O \times O)$ and $N: T \rightarrow \wp(O \times O)$
(3) For all $t \in T$: $\langle O, P(t), N(t) \rangle \in HG$

Axiom (2) of Definition 4 says that P and N are functions that assign to every $t \in T$ exactly one element from the power set O x O. Note, that P and N now are characterized differently than before. Axiom (3) claims that the triple $\langle O, P(t), N(t) \rangle$ is a Heider-graph for all $t \in T$. This axiom contains implicitly the assumption that all objects remain the same across the time period considered. Without this requirement, it would be possible to connect two quite different object sets O, O' to a balance system which have nothing at all in common. To illustrate Definition 4: if U and G are the balanced and imbalanced triads of Definition 3, and t_1 to t_6 is a class of ordered point of times, the following structure is a potential model of the Heider-theory:

(Ex3)	t_1	t_2	t_3	t_4	t_5	t_6
	U	G	U	G	U	U

Definition 5:
For any $\mathbf{x} = \langle O, T, <, P, N \rangle \in \mathbf{M_p(HT)}$ we abbreviate $\langle O, P(t), N(t) \rangle$ by $\mathbf{x(t)}$.

Definition 6 completes the potential models of the Heider-theory by adding the 'balance axiom'. Empirical structures that satisfy the balance axiom are models of **HT**.

Definition 6:

$\mathbf{x} = \langle O, T, <, P, N \rangle$ is a *model* of Heider's theory ($\mathbf{x} \in \mathbf{M(HT)}$) iff there exist O, T, $<$, P and N, such that:

(1) $\mathbf{x} \in \mathbf{M_p(HT)}$

(2) For all $t \in T$ and for all a: if $t < \max(T)$ and $a \in TR_{\mathbf{x}(t)}$ and $a \in U_{\mathbf{x}(t)}$, then there exist $t' \in T: t < t'$ and $a \in G_{\mathbf{x}(t')}$ and for all $t'' > t'$: $a \in G_{\mathbf{x}(t'')}$.

Axiom (2) represents Heider's core proposition, which claims that across a sufficient period of time, imbalanced triads are always transformed into balanced ones. This axiom forms the fundamental law of balance theory. In the present reconstruction, it is expressed by saying that for all points of time t and all triads a: If t is smaller than the maximum of T and a is imbalanced at t, then there is $t' > t$, where a is in balance and for all t'' larger than t', a remains balanced. Whereas example Ex3 does not satisfy the model definition, the following example Ex4 is a model of the Heider-theory:

(Ex4)	t_1	t_2	t_3	t_4	t_5	t_6
	U	U	U	G	G	G

In Axiom 2 the last conjunction following the existence quantifier (for all $t'' > t$: $a \in G_{\mathbf{x}(t'')}$) is necessary. Were it omitted, it would be possible that, after a change of an imbalanced triad into a balanced one, a re-change into an imbalanced triad could occur again at a later time. From our view Heider wanted to exclude such a situation. Example Ex5 illustrates this forbidden re-change:

(Ex5)	t_1	t_2	t_3	t_4	t_5	t_6
	U	U	U	G	U	U

The fundamental law (6-2) was held deliberately vague in that it leaves unspecified (a) which relations are changed, and (b) within which time period. However, this corresponds precisely to Heider's intention.

Besides the class of models and potential models, there remains, as a third structuralist model type, the class of partial potential models $\mathbf{M_{pp}}$. For the definition of $\mathbf{M_{pp}}$, one has to decide the question of which concepts of the Heider-theory can be determined independently of that theory, and which cannot. More precisely speaking, one has to distinguish between **T**-theoretical terms, which presuppose the law of the Heider-theory and **T**-non-theoretical terms, which do not presuppose **HT**. To be brief, all concepts of **HT** can be determined independently of **HT**: neither for the determination of persons and objects, nor for the determination of the relations, must **HT** be presupposed. The measurement of the relations may be problematic, since *P* and *N* are attitudes and the determination of attitudes is theory-guided like all attitude measurement. However, theoretical terms of a presupposed theory of attitude measurement are non-theoretical with respect to **HT** (see also Stephan 1990, p.75). Therefore, there are no **HT**-theoretical terms in the Heider-theory and consequently it is not necessary to distinguish between partial potential models and potential models of the theory.

Because **HT** is an empirical theory, the particular parts of reality which it is intended to apply to must be added to the formal core **M** and $\mathbf{M}_p$. This 'domain of intended applications', denoted by **I**, is given in a purely pragmatical way by examples. Intended applications of balance theory **I(HT)** are given primarily in (Heider 1958), who mentions a variety of examples and experiments that can be interpreted as successful applications of the core of **HT**: **I** = {choice of a partner, xenophobia, possession, political elections, ... }.

The experiments of (Jordan 1953), (Lerner, Simmons 1966) and (Landy, Aronson 1969) are also examples for intended, and successful, applications of the Heider-theory. In general these systems can be best described as (triadic) attitude systems. For these systems the empirical claim of **HT** can be formulated that they are models of the Heider-theory:

$$\mathbf{I(HT)} \subseteq \mathbf{M(HT)}.$$

The empirical claim says that every intended application of the Heider-theory - every triadical attitude system - is an actual model of **HT**. That is, for all $\mathbf{x} \in \mathbf{I(HT)}$, the balance axiom is satisfied.

The class **I** is given independently of the mathematical structure: it is an open class that can be expanded in the historical course, but can also become smaller if applications of the theory core fail. **HT** is a good example for these two features of **I**. Heider himself has given some examples where his theory is not applicable. Attitude systems which are not in the range of **I** are those concerned with jealousy, envy and competition (Heider 1946, pp.110-111, 1958, p.233). A few years later, other authors pointed out that the theory can not be applied to certain triadic attitude systems. (Berger *et al.* 1962, pp.9-36) showed that the balance rule does not apply in norm-determined situations. For example, the triadic structure - a man likes a women, he likes alcoholic drinks whereas the women dislikes alcohol –is imbalanced but stable because this situation corresponds to an existing social norm. Berger *et al.* interpret this finding in a 'structuralist manner': "These exceptions are not so much a gap in

Heider's theory as an indication of the way in which its scope is to be defined and limited" (Berger *et al.* 1962: p.13). In structuralist terminology, these applications are not to be included into **I**. A more detailed discussion of the problem of intended applications is given later.

III. The Balance Theory of Holland and Leinhardt

The original balance theory of Heider is a very specific, restricted theory-element, both with regard to the theory-core and to its intended applications: **HT** considers only systems consisting of *three elements* with *cognitive* representations of *valued relations*. In the 1970ies Paul W. Holland and Samuel Leinhardt developed a theory that, they claimed, includes Heider's balance theory as a special case (Holland, Leinhardt 1971). Intended applications of this theory are interpersonal relations in social networks. The fundamental law is that in (certain) social networks, there is a tendency toward transitive relations. For example, if A is a friend of B and B a friend of C, then - so the rule of transitivity claims - A will tend to become a friend of C. The law of transitivity is traced back by Holland and Leinhardt to Heider: In his first article, he characterized L- and U-relations as 'psychologically transitive': "Logically, L is not transitive but there exists a psychological tendency to make it transitive when implications between U relations do not interfere with transitivity. The relation U, too, seems to be in this sense psychologically transitive" (Heider 1946, pp.109-110).

Formally, the Holland-Leinhardt-theory considers graphs with nodes and directed relations or edges between them. We introduce the following notational conventions:

Definition 7:
If $\langle X, R\rangle$ is a structure with a finite set X and a dyadic relation R, then for all $x,y \in X$:
(1) xMy iff xRy and yRx
(2) xAy iff xRy and not yRx
(3) xNy iff not xRy and not yRx.

Sociometrically interpreted, M denotes mutual choices, A denotes asymmetric or unreciprocated choices, and N denotes null or mutual non-choices.

The following definitions are completely analogous to those of Heider's theory and need no commentary. In the definition of the potential models $<X,R>$ is again applied to a set of time points. To the **T**-theoretical terms the same remarks apply as in the case of Heider's theory: None of the terms of the Holland-Leinhardt-theory is **T**-theoretical.

Definition 8:
$\mathbf{x} = \langle X, T, <, R\rangle$ is a *potential model* of the Holland-Leinhardt-theory ($\mathbf{x} \in \mathbf{M_p(HLT)}$) iff there exist X, T, $<$, R such that:
(1) X is a finite, non-empty set
(2) $\langle T, <\rangle$ is a finite linear order
(3) $R : T \rightarrow \wp(X \times X)$

Definition 9:
For any $\mathbf{x} = \langle X, T, <, R \rangle \in \mathbf{M_p(HLT)}$ we abbreviate $\langle X, R(t) \rangle$ by $\mathbf{x(t)}$.

The concept of 'transitivity' now replaces the concept of 'balance'. A completely transitive friendship network has some interesting formal properties (see Holland, Leinhardt 1971): A transitive graph can be partitioned into cliques such that (a) within each clique all pairs of individuals are joined by M-edges; (b) between any two distinct cliques, all pairs of individuals are either all joined by A-edges with the same direction, or by N-edges; (c) the cliques, when ordered, form a partial order. In other words: transitivity leads to the development of hierarchies as well as cliques.

However, empirical transitive friendship networks are an exception. Completely transitive structures may be seen as the borderline case of the development of an empirical system. Therefore, the fundamental law of the Holland-Leinhardt-theory only says that empirical systems have a *tendency* toward transitive structures. The models of **HLT** can be defined by the condition that for a certain $< X,R >$-structure an index of transitivity is introduced, which must increase (or remain the same) over an adequately long time interval. This index can be constructed by comparing the number of intransitive triples with the number of all possible triples. The index of transitivity reaches a maximum if there are no intransitive triples, and it is a minimum if there are only intransitive triples. More precisely, if $\mathbf{x}$ is an **HLT**-structure, the index of transitivity $TRX(x)$ can be defined as follows:

$$TRX(x) = 1 - \frac{\text{number of all intransitive triads}}{\text{number of all possible triads}}$$

The number of all possible triads in a graph of cardinality n is given by:

$$\frac{n \cdot (n-1) \cdot (n-2)}{6}$$

Definition 10 defines the cardinality and the index of transitivity of a graph.

Definition 10:
If $\mathbf{x} = < X, T, <, R > \in \mathbf{M_p(HLT)}$ and $t \in T$, then n and $TRX(\mathbf{x}_t)$ are defined as follows:
(1) n=card(X)

(2) $TRX(\mathbf{x}_t) := 1 - \dfrac{\text{card}\{\langle x,y,z\rangle | \, x,y,z \in X \wedge xRy \wedge yRz \wedge \neg xRz\} \cdot 6}{n \cdot (n-1) \cdot (n-2)}$

The models of the Holland-Leinhardt theory can now be easily defined by reference to the index of transitivity.

Definition 11:
$\mathbf{x} = \langle X, T, <, R \rangle$ is a model of **HLT** ($\mathbf{x} \in \mathbf{M(HLT)}$) iff
(1) $x \in \mathbf{M_p(HLT)}$
(2) For all $t, t' \in T$: if $t < t'$ then $TRX(x_t) \leq TRX(x_{t'})$

The fundamental law (2) expresses the 'trend towards transitivity'. It means, that - given a certain **HLT**-structure - for any two points of time t and t' with $t' > t$ the index of transitivity at t' is larger than at t, or remains the same. In other words: over the time period from t to t', transitivity (and therefore balance) either remains constant or increases. Table 1 illustrates the model definition with three fictional examples. The numbers in the lines indicate the development of the indices of transitivity at six points of time. According to Definition 11, the potential models S1 and S2 are models of **HLT**, whereas S3 is not a model of **HLT**.

M_n	Time t_1	t_2	t_3	t_4	t_5	t_6
S_1	0,3	0,3	0,5	0,6	0,6	0,7
S_2	0,6	0,6	0,6	0,6	0,6	0,6
S_3	0,4	0,2	0,2	0,4	0,4	0,5

Table 1: Three examples of possible temporal developments of the transitivity index. The potential models S_1 and S_2 are models of **HLT**.

Note that the degree of transitivity does not have to increase for a given time interval in this reconstruction, but it can remain the same (see S2 of Table 1).

Because **HLT** and **HT** are members of the same research program, the question of the relationship between these theories arises. Although intertheoretical relations are not the subject of the present reconstruction, a brief comment seems appropriate. On the basis of the described reconstruction, it can be easily shown that the Heider-theory can be formally reduced to the Holland-Leinhardt-theory and that the 'younger' theory in history means an improvement (Manhart 1995, 1998). Using the reduction relation as defined in *Architectonic*, every application of the Heider-theory can be translated into an application of the Holland-Leinhardt-theory. The reduction relation restricts the number of elements to three and identifies the *P*- and *N*-relations of **HT** with the *M*- and *N*-relations of **HLT**.

IV. Intended Applications of Balance Theories

Intended applications of Heider's theory were restricted triadical attitude systems, intended applications of the Holland-Leinhardt-theory are interpersonal relations: "While Heider was concerned with cognitive balance involving at most three entities, we are interested in the structural consequences of transitive graphs of actual interpersonal relations among many individuals" (Holland, Leinhardt 1971, p.108). More precisely, (Holland, Leinhardt, 1971, pp.107-109) focus on friendship networks (small groups with 'sentiment relations') as intended applications. *X* is interpreted as a set of individuals and *R* as a sentiment relation. This set forms the one and only application of **HLT** suggested by the originators of the theory:

$$\mathbf{I(HLT)} := \{\text{social groups with sentiment relations}\}.$$

For these systems of social groups, the application of the core of **HLT** was successful. (Davis 1970) confirmed **HLT** by an analysis of 742 empirical socio-matrices of small groups. A similar investigation of 51 different socio-matrices with an analogous result was carried out by (Hallinan 1974). A third positive test was done by (Holland, Leinhardt 1975).

In the structuralist program, well-confirmed applications of a theory-core are denoted as a domain **F(I)** of firm applications (Stegmüller 1986, p.111). Thus, social groups with sentiment relations are a firm, well-confirmed domain of applications of **HLT**. Furthermore, because **HLT** can also deal with the applications of **HT**, we can add Heider's attitude systems into the set of firm applications of **HLT**:

F(I(HLT)) := **I(HT)** $\cup$ **I(HLT)** = {triadical cognitive attitude systems, social groups with sentiment relations}.

Elements	***Relations***
(A) Cognitive elements: represented persons Attitude objects Propositions	Cognitive relations: Liking and unit relations in Heider
(B) Persons	Interpersonal relations: (1) Sociometric choices (2) Communication (3) Interaction: Helping, Giving (4) Power and influence
(C) Groups, organizations	Intergroup relationships (1) Alliance/wars (2) Trade
(D) Nations	International relationships (1) Alliance/wars (2) Trade

Table 2: Proposed applications for balance theories (Cartwright, Harary 1979, p.27)

In the 1970ies and 1980ies, a number of scientists proposed to enlarge the elements of **I** by including other, similar social groups. From the structuralistic viewpoint, this corresponds to the 'paradigmatic method': starting with a number of 'core examples' of applications, one tries to enlarge the set of applications step-by-step by intuitive considerations of analogy (*Architectonic*, p.39). As a rule, however, the scientists who work with the theory will not reach complete agreement on the applications; that is, there will remain some dispute about which systems the theory should treat. These applications of the theory that are not, or less well confirmed, may be accepted only by a subgroup - in the extreme case, only by a single member - of the scientific community. This subset of **I** is called the 'domain of assumed applications' **A(I)**, where **F(I)** $\cup$ **A(I)** = **I**.

The Holland-Leinhardt-theory is a good example for the paradigmatic method. This example shows that the structuralist view of theories corresponds indeed to real processes in the scientific community. Starting with the core application of friendship networks, some balance theorists proposed to include other empirical examples that are similar to the elements of **F(I(HLT))** They believed or at last hoped that the core **K(HLT)** would also be applicable to these assumed applications **A(I(HLT))**. Table 2 gives an overview of all firm and assumed applications of **HLT** (firm applications are emphasized).

With the exception of the firm applications (A) and (B) (1), all examples can be regarded as assumed applications. According to this table, the set of assumed applications can be defined as:

A(I) := {power systems, communication systems, organizations, nations, ...}

All elements of **A(I)** can be represented in the conceptual frame of **HLT** and can be considered as potential models of **HLT**: **A(I(HLT))** $\subseteq$ $\mathbf{M_p}$. If one looks at the members of A(**I**) 'through the glasses' of **HL**-theory, one gets for example the following interpretations: an intended system of (B) would be a communication system in which X is a set of persons and R a communication relation '...gives information to ...'. In these systems, cliques would be persons who exchange information, whereas in hierarchical cliques, communication would go only in one direction and isolated cliques would have no communicative relation. In an example of (C), X can be interpreted as a set of organizations - e.g. companies - and R as a trade relation. Thus, a clique of organizations would be companies making transactions among themselves and cliques at different levels would correspond to clusters of organizations, who have trade in only one or no direction.

In the 1970ies, a lively discussion started on the question as to which of these examples the **HL**- and balance-theories are actually applicable. This discussion clearly verifies the structuralist interpretation that the applications of a theory aren't connected automatically with that theory but can be regarded as independent of it. (Anderson 1979) claimed that transitivity tendencies are correct for small sociometric groups, whereas in institutional contexts with instrumental transactions this principle is not applicable. For example, in politics, intransitive triads are very common and stable; transitivity here seems far less necessary than in friendship networks. If a nation A is politically allied with B and B with C, then even in the long run, A can be either politically allied with C *or not*. In another context, A can have stable relations to both B and C even though B and C are political enemies.

In the same way as (Anderson, Hallinan, Felmlee 1975) and (Granovetter 1973, 1979) also doubt that transitivity is a general structural characteristic of social formations. For Granovetter, transitivity is primarily a function of the intensity of the relations; therefore the applicability of balance theories to institutional units is hardly plausible. For example, in politics there are too many interest conflicts between contrary groups and protagonists to block the assumption that a common enemy always would lead to common alliances and cooperations. Whereas it is easy in small groups to change attitudes towards persons in order to produce balance, in larger contexts the negative relations are embedded so tightly into institutional substructures that they cannot be that easily changed.

Studies by (Hallinan, Felmlee 1975) suggest indeed that transitivity is an organizational principle that holds exclusively for friendship networks with sentiment relations. Using the above-described sociometric data it was shown that sentiment relations are less strongly intransitive than other relations. Furthermore, the intensity of the sentiment relation has effects on transitivity: the more intense friendship relations are, the less intransitivity exists in the social net. Intransitivity seems to be 'psychologically more painful' in intensive than in loose relations.

This short summary of some of the central discussions of **HLT** demonstrates that the intended systems of the theory are controversial. Cases in which the domain of applications is not clear are not a specific characteristics of the social sciences, but are found frequently in the history of natural science. The best known example is classical particle mechanics: for a certain period of time, it was unclear whether Newton's theory can also explain light phenomena in addition to the paradigmatic examples - the solar system, its sub-systems and so on.

Although in the described discussion, strong arguments against the enlargement of the set of firm applications of **HLT** were brought forward, the decision in this controversy should be made on strong empirical grounds. Using the 'method of autodetermination' the theory's formalism itself is left with the responsibility of deciding what its applications are. "The combination of the paradigmatic method with the method of autodetermination gives rise to a step-by-step determination of the theory's empirical domain in the course of its historical evolution" (*Architectonic*, p.39). The investigation of (Hallinan, Felmlee 1975) is a first starting point with important results. Further studies should be made to confirm the domain of **HLT** and to determine it more precisely.

V. Conclusions

When (Anderson 1979, p.456) raised the question of why the balance theory was empirically so successful despite the fact that counterexamples to its assertions can be easily found, the author had in mind the idea of a single, 'cosmic' application. If this fiction is replaced by the assumption that every theory has different, partly overlapping applications, the apparent contradiction disappears: balance theory was empirically successful because it can explain a certain set of intended systems, whereas the 'counterexamples' are not applications of the theory. Some balance scientists argue - without referring to structuralism - in exactly this way. For example, when (Hallinan 1974) reports data which contradict the predictions of one version of balance theory, he attributes this to an inadequate use of the theory: "I have found that an inappropriate application of the theory is responsible for the unsuccessful predictions of the model" (Hallinan 1974, p.365). Hence the structuralistic view on theories is closer to the intuition and actual behavior of social scientists.

Ludwig-Maximilians-Universität München
e-mail: klaus@pr-manhart.m.eunet.de

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